Chapter Three
FACILITY REQUIREMENTS

Chapter Three

Facility Requirements

To properly plan for the future of San Manuel Airport, it is necessary to translate forecast aviation demand into the specific types and quantities of facilities that will serve this identified demand. This chapter uses the results of the forecasts conducted in Chapter Two, as well as established planning criteria to determine the airfield (i.e., runways, taxiways, navigational aids, marking and lighting), and landside (i.e., hangars, general aviation terminal building, aircraft parking apron, fueling, automobile parking and access) facility requirements.

Chapter Three will identify, in general terms, the adequacy of the existing airport facilities, outline what new facilities may be needed, and when these may be needed to accommodate forecast demands. Having established the facility requirements, alternatives for providing these facilities will be evaluated in Chapter Four to determine the most cost-effective and efficient means for implementation.

AIRFIELD REQUIREMENTS

Airfield requirements include those facilities related to the arrival and departure of aircraft. These facilities are comprised of the following items:

- Runways
- Taxiways
- Airfield Marking and Lighting
- Navigational Aids

The selection of appropriate Federal Aviation Administration (FAA) design standards for development of airfield facilities is based primarily upon the characteristics of aircraft which are expected to use the airport. The definitive characteristics are approach speed and wingspan of the critical design

aircraft. The critical design aircraft is defined as the most demanding category of aircraft which conducts 500 or more operations per year.

CRITICAL AIRCRAFT

The FAA has established criteria for use in the sizing and design of airfield facilities. These standards include criteria which relate to aircraft size and performance. According to FAA *Advisory Circular (AC) 150/5300-13, Change 6, Airport Design*, an aircraft's approach category is based upon 1.3 times its stall speed in landing configuration at that aircraft's maximum certificated weight. The five approach categories used in airport planning are as follows:

Category A: Speeds of less than 91 knots.

Category B: Speeds of 91 knots or more, but less than 121 knots.

Category C: Speeds of 121 knots or more, but less than 141 knots.

Category D: Speeds of 141 knots or more, but less than 166 knots.

Category E: Speeds of 166 knots or greater.

The second basic design criteria relates to aircraft size. The airplane design group (ADG) is based upon wingspan. The six groups are as follows:

Group I: Up to but not including 49 feet.

Group II: 49 feet up to but not including 79 feet.

Group III: 79 feet up to but not including 118 feet.

Group IV: 118 feet up to but not including 171 feet.

Group V: 171 feet up to but not including 214 feet.

Group VI: 214 feet or greater.

Together, approach category and ADG correspond to a coding system whereby airport design criteria are related to the operational and physical characteristics of the aircraft intended to operate at the airport. The airport reference code (ARC) has two components. The first component, depicted by a letter, is the aircraft approach category. The second component, depicted by a Roman numeral, is the airplane design group. Generally, aircraft approach speed applies to runways and runway-related facilities, while airplane wingspan primarily relates to separation criteria involving taxiways and taxilanes.

Exhibit 3A provides a listing of typical aircraft and their associated ARC. **Table 3A** indicates a listing by their ARC of typical aircraft of the type that might be expected to be used at an airport similar to San Manuel Airport. Information is also given on approach speed and wingspan - the characteristics that determine ARC.

01MP17-3A-5/9/03

A-I

Beech Baron 55
Beech Bonanza
Cessna 150
Cessna 172
Piper Archer
Piper Seneca

C-I, D-I

Lear 25, 35, **55**
Israeli Westwind
HS 125

B-I
less than 12,500 lbs.

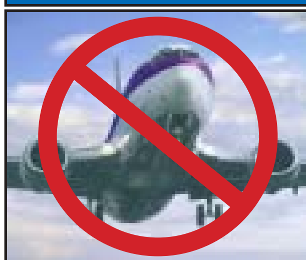
Beech Baron 58
Beech King Air 100
Cessna 402
Cessna 421
Piper Navajo
Piper Cheyenne
Swearingen Metroliner
Cessna Citation I

C-II, D-II

Gulfstream II, **III**, IV
Canadair 600
Canadair Regional Jet
Lockheed JetStar
Super King Air 350

B-II
less than 12,500 lbs.

Super King Air 200
Cessna 441
DHC Twin Otter

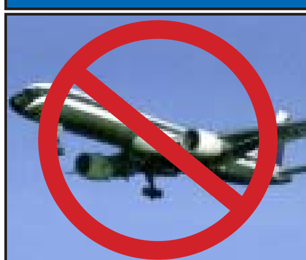


C-III, D-III

Boeing Business Jet
B 727-200
B 737-300 Series
MD-80, DC-9
Fokker 70, 100
A319, A320
Gulfstream V
Global Express

B-I, II
over 12,500 lbs.

Super King Air 300
Beech 1900
Jetstream 31
Falcon 10, 20, 50
Falcon 200, 900
Citation II, III, IV, V
Saab 340
Embraer 120

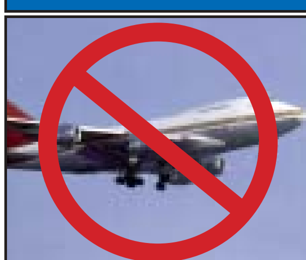


C-IV, D-IV

B-757
B-767
DC-8-70
DC-10
MD-11
L1011

A-III, B-III

DHC Dash 7
DHC Dash 8
DC-3
Convair 580
Fairchild F-27
ATR 72
ATP



D-V

B-747 Series
B-777

Note: Aircraft pictured is identified in bold type.

San Manuel AIRPORT

Exhibit 3A
AIRPORT REFERENCE CODES

TABLE 3A
Representative General Aviation Aircraft by ARC

Airport Reference Code	Typical Aircraft	Approach Speed	Wingspan (feet)	Maximum Takeoff Weight (lbs)
	Single Engine Piston			
A-I	Cessna 150	55	32.7	1,600
A-I	Cessna 172	64	35.8	2,300
A-I	Beechcraft Bonanza	75	37.8	3,850
	Turboprop			
A-II	Cessna Caravan	70	52.1	8,000
	Multi Engine Piston			
B-1	Beechcraft Baron	96	37.8	5,500
B-1	Piper Navajo	100	40.7	6,200
B-1	Cessna 421	96	41.7	7,450
	Turboprop			
B-1	Mitsubishi MU-2	119	39.2	10,800
B-1	Piper Cheyenne	119	47.7	12,050
B-1	Beechcraft King Air B-100	111	45.8	11,800
	Business Jets			
B-1	Cessna Citation I	108	47.1	11,850
B-1	Falcon 10	104	42.9	18,740
	Turboprop			
B-II	Beechcraft Super King Air	103	54.5	12,500
B-II	Cessna 441	100	49.3	9,925
	Business Jets			
B-II	Cessna Citation II	108	51.7	13,330
B-II	Cessna Citation III	114	53.5	22,000
B-II	Cessna Citation Bravo	114	52.2	15,000
B-II	Cessna Citation Ultra	109	52.2	16,500
B-II	Falcon 20	107	53.5	28,660
B-II	Falcon 900	100	63.4	45,500
	Business Jets			
C-1	Lear 55	128	43.7	21,500
C-1	Rockwell 980	137	44.5	23,300
C-1	Lear 25	137	35.6	15,000
	Turboprop			
C-II	Rockwell 980	121	52.1	10,325
	Business Jets			
C-II	Canadair Challenger	125	61.8	41,250
C-II	Gulfstream III	136	77.8	68,700
	Business Jets			
D-I	Lear 35	143	39.5	18,300
D-II	Gulfstream II	141	68.8	65,300
D-II	Gulfstream IV	145	78.8	71,780

The FAA advises designing all elements to meet the requirements of the airport's most demanding, or critical, aircraft. As discussed above, this is the aircraft, or family of aircraft, that performs greater than 500 itinerant operations per year. Once the ARC of the critical aircraft is determined, application of the appropriate design criteria can begin.

According to FAA statistics, active general aviation turbine aircraft are expected to increase on an average annual basis of 2.2 percent over the next decade. Once utilized only by larger corporations, corporate aircraft (especially jets) have been increasingly utilized by a wider variety of companies.

Also, as companies shift away from downtown locations to suburban areas and smaller communities, utilization of corporate aircraft has become a cost-effective manner in which to transport executives and other personnel. The cost benefit can be attributed to the newer, fuel efficient jet aircraft which can close the expense gap between the seat on the corporate jet versus the seat on the commercial carrier.

The community of San Manuel and, by association, the airport have been historically tied to the copper industry. As extraction became more involved and expensive, the mine decreased production and, subsequently, changed hands. Extraction techniques have made mining more feasible in older mines and San Manuel has one of the most complete and modernized facilities in the U.S. However, the copper industry is at a point of bottoming-out in value in the world market. While the future of the mining industry in San Manuel is in flux, the community of San Manuel has become more independent from the economy of the mine. Therefore, even though BHP Billiton-related air traffic will likely continue to contribute to corporate aircraft activity at San Manuel Airport, future economic growth and development of San Manuel and the expanded tri-community area may be the long term impetus for corporate/ business aircraft use.

Aircraft conducting more than 500 annual operations at San Manuel Airport currently fall within ARC B-I. This includes aircraft ranging from small single and multi-engine piston aircraft to the more sophisticated turboprop and occasional jet aircraft. The future mix of aircraft operations at San Manuel Airport can be expected to be performed by a wider range of small, single and multi-engine aircraft from Categories A and B and Groups I and II, with increased corporate aircraft utilization, as Tucson area airports and airspace become more crowded and as the tri-community area continues to grow. Furthermore, FAA data on general aviation business jet aircraft suggest that the Cessna and Lear series jet aircraft comprise the largest portion of active business jet aircraft. Within the planning time-frame of this report, the less demanding of these series of aircraft should be considered for accommodation. The series of Cessna Citation aircraft fall within ARC B-I and B-II. For planning purposes, the most critical aircraft having 500 or more annual operations at San Manuel Airport is a combination of several aircraft which fall into Category B and

ADG II, represented by the Beech King Air, the Cessna Citation (Category B aircraft) and the Cessna Caravan, Air Tractor, Beech King Air, and the Cessna Citation II and III (ADG II aircraft). Therefore, the long term critical aircraft category and group for San Manuel Airport is ARC B-II.

The airfield facility requirements outlined in this chapter correspond to the design standards described in the FAA *Advisory Circular 150/5300-13, Airport Design*. The following airfield facilities are outlined to describe the scope of facilities that would be necessary to accommodate the airport's role throughout the planning period.

RUNWAYS

The adequacy of the existing runway system at San Manuel Airport has been analyzed from a number of perspectives, including runway orientation, airfield capacity, runway length, and pavement strength. Using this information, requirements for runway improvements have been determined for the airport.

Airfield Capacity

A demand/capacity analysis measures the capacity of the airfield facilities (i.e. runways and taxiways) in order to identify and plan for additional development needs. The capacity of the airport's one runway system is approximately 210,000 annual operations.

FAA Order 5090.3B, *Field Formulation of the National Plan of Integrated Airport Systems* (NPIAS) indicates that improvements should be considered when operations reach 60 percent of the airfield's annual service volume (ASV). Even if the projected long range planning horizon level of operations comes to fruition prior to projections, the airfield's ASV will not exceed the 60 percent level by the long range planning horizon. Therefore, no additional airfield improvements aimed at increasing airfield capacity will be required for the planning period.

Runway Orientation

The current airfield configuration includes the single Runway 11-29, which is oriented in a west-northwest/east-southeast manner. Ideally, the primary runway at an airport should be oriented as close as practical in the direction of the predominant winds to maximize the runway's usage. This minimizes the percent of time that a crosswind could make the preferred runway inoperable.

FAA *Advisory Circular (AC) 150/5300-13, Airport Design* recommends that a crosswind runway should be made available when the primary runway orientation provides less than 95 percent wind coverage for any aircraft forecast to use the airport on a regular basis. The 95 percent wind coverage is computed on the basis of the crosswind component not exceeding 10.5 knots (12 mph) for ARC (ARC) A-I and B-I; 13 knots (15 mph) for ARC A-II and B-II; and 16 knots (18 mph) for ARC C-I through D-II.

Wind information was gathered from Tucson International Airport weather station, the nearest weather reporting facility. The 1991 *San Manuel Airport Master Plan* has also been consulted to verify this information. The wind rose in **Exhibit 3B** indicates that the single Runway 11-29 is adequate to meet 94.96 percent coverage for 12 mph crosswinds and 97.12 percent at 15 mph. The analysis indicates that Runway 11-29 provides adequate crosswind coverage for ARC A-I, B-I, and B-II aircraft and is in agreement with the previous master plan.

The lack of available wind data suggests the need for an automated weather observation system (AWOS) at San Manuel Airport. The AWOS could be used to verify this analysis for future facility planning.

Runway Length

The determination of runway length requirements for the airport are based on five primary factors:

- Critical aircraft type expected to use the airport;
- Stage length of the longest nonstop trip destinations;
- Mean maximum daily temperature of the hottest month;
- Runway gradient; and
- Airport elevation.

As stated, an analysis of the existing and future fleet mix indicates that small business jets will be the most demanding aircraft at San Manuel Airport. The typical existing business aircraft range from the Cessna Caravan (A-II) and Beech King Air (B-II) to the Cessna Citation I and II (B-I and B-II). Typical business jets were identified in **Table 3A**.

Aircraft operating characteristics are affected by three of the five primary factors above. They are the mean maximum daily temperature of the hottest month, the airport's elevation, and the gradient of the runway. Where local weather information was unavailable, weather information from Tucson, the nearest weather reporting station, has been used. The mean maximum daily temperature of the hottest month of the year (June) for San Manuel is 95.8 degrees Fahrenheit (F) (from the *San Manuel Miner* weekly newspaper). The airport elevation at San Manuel is 3,274 feet MSL. The effective gradient for Runway 11-29 is 0.83 percent.

The runway length requirements for San Manuel Airport have been determined by incorporating the variables stated previously into the FAA airport design computer program, *Airport Design, Version 4.2D* based upon *Advisory Circular (AC) 150/ 5300-13, Airport Design*. **Table 3B** outlines the runway length requirements for various classifications of aircraft as calculated by this program.

Upon analysis of the current and forecasted aircraft fleet mix projected through the long range planning period, it has been determined that San Manuel Airport should be designed to

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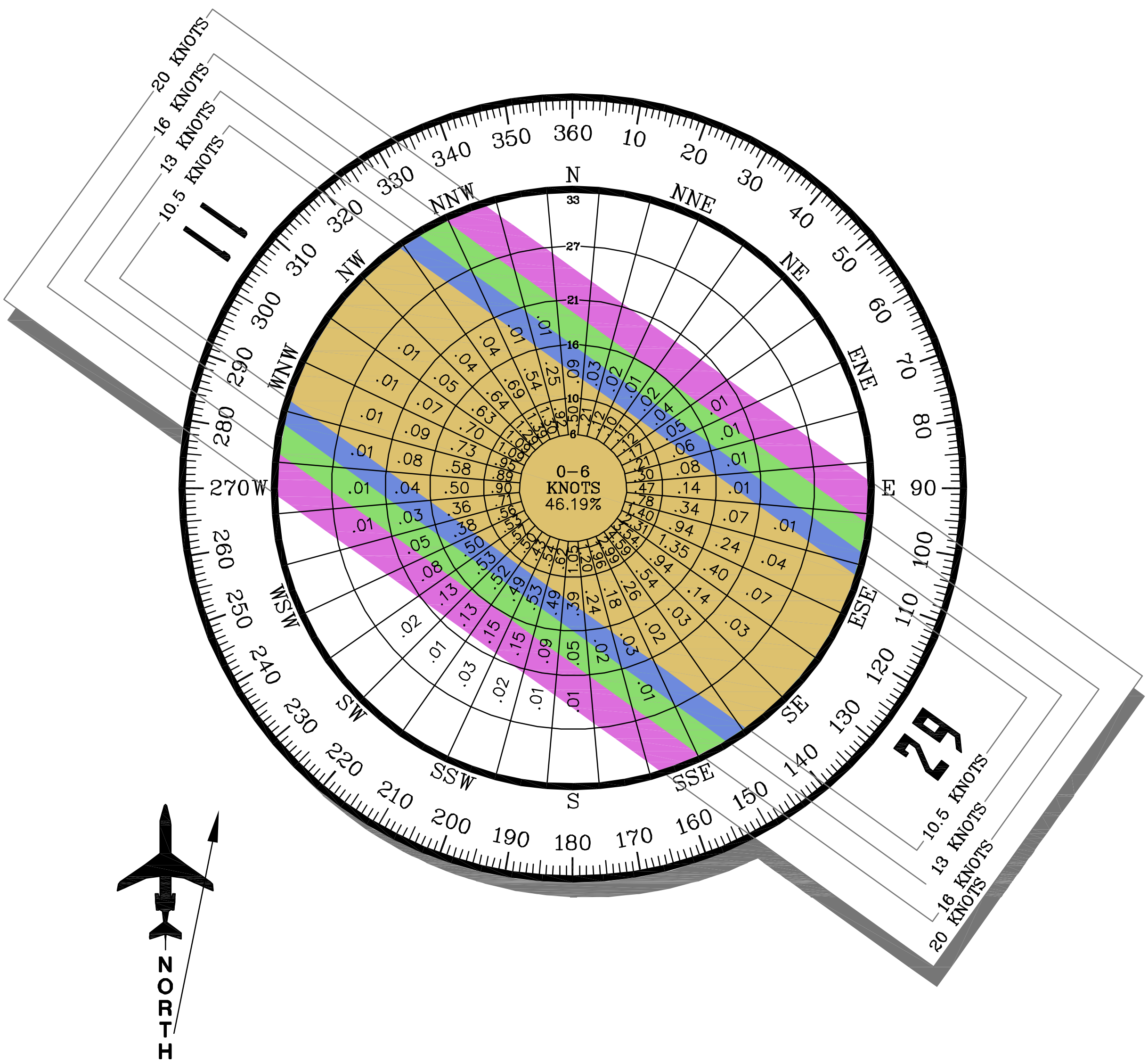
ALL WEATHER WIND COVERAGE

Runways	10.5 Knots	13 Knots	16 Knots	20 Knots
Runway 11-29	*94.96%*	*97.12%*	*99.01%*	*99.75%*

SOURCE:
NOAA National Climatic Center
Asheville, North Carolina
Tucson International Airport
Tucson, Arizona

OBSERVATIONS:
83,644 All Weather Observations
1988-1997



Magnetic Variance
11° 26' East (January 2002)
Annual Rate of Change
3.16' West (January 2002)

San Manuel AIRPORT

Exhibit 3B
WINDROSE

accommodate B-II category aircraft. The B-II designation enables the primary runway, under given variables of temperature, elevation, gradient and 500-mile trip length, to accommodate 95 percent of "small aircraft with 10 or less passenger seats". As calculated for San Manuel Airport, the recommended ARC B-II runway length is 4,800 feet. The current length of Runway 15-33 is 4,214 feet, falling short of this design group standard.

TABLE 3B
Runway Length Requirements
San Manuel Airport

AIRPORT AND RUNWAY DATA	
Airport elevation	3,274 feet
Mean daily maximum temperature of the hottest month	95.80 F
Maximum difference in runway centerline elevation	20 feet
Length of haul for airplanes of more than 60,000 pounds	500 miles
Dry runways	
RUNWAY LENGTHS RECOMMENDED FOR AIRPORT DESIGN	
Small airplanes with less than 10 passenger seats	
75 percent of these small airplanes	3,800 feet
95 percent of these small airplanes	**4,800feet**
Small airplanes with 10 or more passengers seats	5,200 feet
Large airplanes of 60,000 pounds or less	
75 percent of business jets at 60 percent useful load	6,100 feet
100 percent of these large airplanes at 60 percent useful load	8,100 feet

REFERENCE: FAA's airport design computer software utilizing Chapter Two of *AC 150/5325-4A, Runway Length Requirements for Airport Design*.

Runway Safety Areas

Consideration of runway length requirements is but one factor among other design criteria established by the FAA. FAA design criteria regarding runway object free area (OFA), runway safety area (RSA), and height clearances must also be examined.

The runway OFA is defined in FAA *Advisory Circular 150/5300-13* and is concurrent with Change 7 (the latest update to the circular), as an area centered on the runway extending out in accordance with the critical aircraft design category utilizing the runway. The OFA must provide clearance of all ground-based objects protruding above the RSA edge elevation, unless the object is fixed by function serving air or ground navigation. **Table 3C** presents airfield planning design standards for Runway 11-29. The following chapter will examine compliance with these standards.

TABLE 3C **Airfield Planning Design Standards (ARC B-II)** **San Manuel Airport**				
	Future **Runway 11-29**			
DESIGN STANDARDS				
Runways				
Length (ft.)	4,800			
Width (ft.)	75			
Pavement Strength (lbs.)				
Single Wheel (SWL)	12,000			
Dual Wheel (DWL)	30,000			
Shoulder Width (ft.)	10			
Runway Safety Area				
Width (feet)	150			
Length Beyond Runway End (ft.)	300			
Object Free Area				
Width (ft.)	500			
Length Beyond Runway End (ft.)	300			
Obstacle Free Zone				
Width (ft.)	400			
Length Beyond Runway End (ft.)	200			
Taxiways				
Width (ft.)	35			
OFA Width (ft.)	131			
Distance to Fixed or Movable Object (ft.)	58			
Runway Centerline to:				
Parallel Taxiway Centerline (ft.)	240			
Aircraft Parking Area (ft.)	250			
Building Restriction Line (ft.)				
20 ft. Height Clearance	390			
33 ft. Height Clearance	481			
Runway Protection Zones	**11**		**29**	
	Approach visibility minimums			
	Not lower than 1 mile	Not lower than 3/4 mile	Not lower than 1 mile	Not lower than 3/4 mile
Inner Width (ft.)	500	1,000	500	1,000
Outer Width (ft.)	700	1,510	700	1,510
Length (ft.)	1,000	1,700	1,000	1,700
Approach Slope	34:1	34:1	34:1	34:1

For ARC B-II OFA design standards at San Manuel Airport, FAA criteria call for a cleared area 500 feet wide (centered on the runway) extending 300 feet beyond the runway.

The RSA is also centered on the runway extending out a specific distance depending on the approach speed of the critical aircraft using the runway. The FAA requires the RSA to be cleared and graded, drained by grading or storm sewers, capable of supporting aircraft, capable of accommodating fire and rescue vehicles, and free of obstacles not fixed by navigational purpose.

In order to meet design criteria for ARC B-II aircraft at San Manuel Airport, the cleared and graded RSA will need to be 150 feet wide (centered on the runway) and extend 300 feet beyond each runway end.

Runway 11-29 currently does not provide adequate area for the required ARC B-II OFA and RSA standards, as objects that fall within this envelope are the hangars, mobile home, and trees next to the home. In Chapter Four, Alternatives the applied standards will be depicted graphically and mitigation measures analyzed.

Runway Width

Runway 15-33 is currently 75 feet wide. FAA design criteria calls for a runway width of 75 feet to serve aircraft in approach category B-II.

Runway Strength

As previously mentioned, the pavement for Runway 11-29 is strength-rated at 12,000 pounds single wheel gear loading (SWL).

Facility planning must consider the possibility of a greater number of higher performance business jets basing or utilizing the airport in the future. In acknowledging that San Manuel Airport will likely upgrade from a B-I to a B-II facility, Runway 11-29 meets current runway strength needs for most aircraft with exception to the Air Tractor whose gross take-off weight is 16,000 pounds. The runway should be improved to achieve 30,000 SWL by the intermediate to long term. It is the responsibility of airport management to ensure that pavement capacities are not exceeded by itinerant aircraft which may fall outside of this design standard.

TAXIWAYS

Taxiways are constructed primarily to facilitate aircraft movements to and from the runway system. Some taxiways are necessary simply to provide access between the aprons and runways, whereas other taxiways become necessary to facilitate safe and efficient separation of air traffic on the airfield.

As detailed in Chapter One, Runway 11-29 is served by a partial-parallel taxiway system and four entrance/exit taxiways. Serving to route traffic in a predominantly parallel fashion, Taxiway A varies from being a full parallel taxiway by approximately 400 feet on the east end due to existing hangars and mobile home which are would lie along the taxiway centerline and taxiway object free areas. Portions of this taxiway are unpaved. Long term facility planning should include extending this runway the full length of the runway and paving the full length of the taxiway.

The B-II distance separation standard between taxiway and runway centerlines is 240 feet. As referenced in Chapter One, Exhibit 1B, the width of partial-parallel Taxiway A is 35 feet where improved, meeting FAA criteria, 15 feet in width where unimproved. In order to accommodate all aircraft currently based and expected to base at San Manuel Airport in the future, all taxiways serving Runway 11-29 should be a minimum of 35 feet wide.

NAVIGATIONAL AIDS, LIGHTING, AND MARKING

Airport and runway navigational aids are based on FAA recommendations as depicted in DOT/FAA Handbook 7031.2B*, Airway Planning Standard Number One* and FAA *Advisory Circular 150/ 5300-2D, Airport Design Standards*, *Site Requirements for Terminal Navigation Facilities*.

Navigational aids provide two primary services to airport operations: precision guidance to a specific runway and/or non-precision guidance to a runway or the airport itself. The basic difference between a precision and non-precision navigational aid is that the former provides electronic descent alignment (course) and position guidance, while the non-precision navigational aid provides only alignment and position location information. The necessity of such equipment is usually determined by design standards predicated on safety considerations and operational needs. The type, purpose and volume of aviation activity expected at the airport are factors in determination of the airport's eligibility for navigational aids.

To determine state navigational aids needs, in 1998 ADOT produced the *Navigational Aids and Aviation Services Special Study*. San Manuel Airport was included in the group of state airports recommended for global positioning systems (GPS) facility installation during Stage III, an eight to ten year timeframe.

The study has further categorized airports with and without approved instrument approach procedures. Ofthe 69 airports without approved instrument approach procedures, San Manuel Airport falls within Group 2. Group 2 airports are defined as those airports which have potential to achieve a GPS approach "provided [that] the costs to improve the airport to applicable standards is at least equal to the anticipated 20-year stream of operational benefits."

Global Positioning System

The advancement of technology has been one of the most important factors in the growth of the aviation industry in the twentieth century. Much of the civil aviation and aerospace technology has been derived and enhanced from the initial development of technological improvements for military purposes. The use of orbiting satellites to confirm an aircraft's location is the latest military development to be made available to the civil aviation community.

Global positioning systems (GPS) use two or more satellites to derive an aircraft's location by a triangulation method. The accuracy of these systems has been remarkable, with initial degrees of error of only a few meters. As the technology improves, it is anticipated that GPS may be able to provide accurate enough position information to allow Category II and III precision instrument approaches, independent of any existing ground-based navigational facilities. In addition to the navigational benefits, it has been estimated that GPS equipment will be much less costly than existing precision instrument landing systems.

The FAA is proceeding with efforts to establish procedures that include vertical guidance and have minimums of approximately 350 feet (height above touchdown) and one mile visibility. Procedures using GPS for traditional precision minimums (200 feet/one mile) may be delayed until after the year 2010 when a second GPS frequency becomes available.

The ADOT *Navigational Aids and Aviation Services Special Study* has recommended in its final GPS analysis that San Manuel Airport receive a GPS approach to Runway 29 with a descent altitude of 305 feet above airport touchdown (HAT) and with a one-mile visibility minimum. This descent altitude is based on a controlling obstruction, noted as terrain at 3,322 feet MSL located 13,000 feet southeast. It is noted also in this report that further obstructions (smokestacks) within one and one half miles east of the airport may also present difficulties in use of Runway 29 for instrument approaches. This proposed procedure is also subject to a standards compliance survey. Associated costs should not exceed $50,500 to be economically feasible.

Airport Visual Approach Aids

Visual glide slope indicators are a system of lights located at the side of the runway which provide visual descent guidance information during an approach to the runway. As mentioned, Runway 11-29 is ready for the installation of PAPIs. The four-box systems are preferred for use, especially by business jet aircraft, due to their high efficiency during instrument weather conditions.

Weather Measurement Equipment

An AWOS (Automated Weather Observing System) is a computerized system that automatically measures one or more weather parameters, analyzes the data, prepares a weather observation that consists of the parameter(s) measured, and broadcasts the observation to the pilot using an integral very high frequency (VHF) radio or an existing navigational aid. The AWOS is a modular system utilizing a central processor which may receive input from several sensors. Basically, there are five standard groups of sensors, however, an AWOS may be certified with any combination of sensors. Dependent upon system design, additional sensors may be certified to any AWOS configuration. At present, there are no weather measurement facilities available at San Manuel Airport. For a more detailed description of the standards of AWOS systems and the types of weather sensors available, please reference *FAA Advisory Circular (AC) 150-5220-16C, Automated Weather Observing Systems For Non-federal Applications*, dated December 13, 1999. Additionally, installation criteria is available in *FAA Order 6560.20B, Siting Criteria For Automated Weather Observing Systems (AWOS),* dated July 20, 1998.

The *Navigational Aids and Aviation Services Special Study*. study also recommends, coincidental to establishment of the GPS approach, the installation of an AWOS-A weather reporting system. There may be further potential for an upgrade to an AWOS-3 based on the following criteria cited in the study:

- The revised forecast of annual aircraft operations per this Master Plan report;

- The recommended statewide distribution of AWOS-3 systems and the gap that an AWOS-3 system at San Manuel Airport could bridge between the Avra Valley Airport and Safford Regional Airport; and

- The unique position of San Manuel Airport north of the Catalina Mountains and along the San Pedro Valley, where frontal activity patterns differ from the closest AWOS-3 systems (45 nautical miles away) due to terrain and elevation changes.

Airfield Lighting And Marking

Runway identification lighting provides the pilot with a rapid and positive identification of the runway end. The most basic system involves runway end identifier lights (REILs). Both REILs and medium intensity runway edge lighting (MIRL) are recommended for use with nonprecision approaches.

Previous planning efforts forecast the need for instrument approach capability. Approach lighting is recommended for use with an instrument approach. The following approach lighting systems are acceptable for nonprecision GPS approaches by FAA *AC 150/1500-13, Change 7* in Table A16-1C: ODALS, MALS, SSALS, or SALS.

A consideration for the instrument approach to Runway 29 (approach from the east, landing to the west) is the height of the set of smokestacks at the mill, 550 feet, or 3,760 MSL, and located one and one-half miles off the runway end. After review, it appears that the smokestacks would be obstacles as they will penetrate the approach slope at either a 20:1 or a 34:1 approach. Therefore, a nonprecision approach to Runway 11 should be considered.

As approaches are improved from visual to nonprecision, so should the basic airport markings be upgraded to nonprecision markings.

All taxiways at San Manuel Airport should be lighted by medium intensity taxiway lighting (MITL).

The airport has a lighted wind cone and a segmented circle which provides pilots with information about wind conditions and traffic pattern circulation. Preparation should be made for night use of the airport. To this purpose, an airport beacon should be installed that assists in identifying the airport from the air at night.

LANDSIDE REQUIREMENTS

Landside facilities are those necessary for handling of aircraft, passengers, and cargo while on the ground. These facilities provide the essential interface between air and ground transportation modes. These areas will be subdivided into two parts: general aviation facilities and support facilities. The capacities of the various components of each area were examined in relation to projected demand to identify future landside facility needs.

GENERAL AVIATION FACILITIES

The purpose of this section is to determine space requirements during the planning period for the following types of facilities normally associated with general aviation terminal areas:

- Hangars
- Aircraft Parking Apron
- General Aviation Terminal
- Vehicle Access
- Vehicle Parking
- Fuel

Hangars

The space required for hangar facilities is dependent upon the number and type of aircraft expected to be based at the airport. Other variables may also influence hangar use. The intensity of weather conditions and the increased demand for storage facilities, in general, are likely to encourage most owners of based aircraft to prefer hangar space to outside tie-downs.

The following tables depicting forecast need are calculated based upon an analysis of existing general aviation facilities and the current and future demands at San Manuel Airport. An initial overview of existing aircraft storage verifies the preference for individual hangars. This is consistent with an overall trend in aviation toward ownership of higher performance aircraft and, many times, of multiple aircraft ownership. Because of this preference, it is necessary to determine what percentages of these aircraft would utilize conventional and executive hangars in addition to individual T-hangars.

T-hangars are relatively inexpensive to construct and provide the aircraft owner more privacy and greater ease in obtaining access to the aircraft. The principal uses of conventional hangars at general aviation airports are for large and/or multiple aircraft storage, storage during maintenance, and for housing fixed base operator activities. Executive hangars provide a storage area typically larger than T-hangars allowing for storage of larger aircraft or multiple small aircraft.

The analysis of hangar storage at San Manuel Airport concludes that all based aircraft are stored in hangars. There is approximately 15,000 square feet of total hangar storage area.

A planning standard of 1,200 square feet per based aircraft stored in T-hangars has been used to determine future T-hangar requirements. A standard of 1,200 square feet has also been applied to each position that would be available within a conventional hangar. Executive hangar requirements were calculated based on a 2,500 square-foot standard per aircraft position. Additional hangar storage square footage has been calculated for maintenance areas based on 15 percent of total storage space needs. These figures were then applied to aircraft to be hangared as determined by based aircraft forecasts. These figures are presented in **Table 3D.**

TABLE 3D
Aircraft Storage Hangar Requirements
San Manuel Airport

	Existing	Future Requirements			
	2001	**2002**	**Short Term**	**Intermediate**	**Long Term**
Aircraft to be Hangared	18	28	31	40	55
T-hangar Positions	3	20	20	22	27
Executive/Individual Hangar Positions	8	3	6	10	18
Conventional Hangar	0	6	6	7	9
Hangar Area Requirements					
T-hangar Area (s.f.)	5,600	23,500	23,500	26,900	32,800
Executive/Individual Hangar Positions	9,800	3,400	10,100	21,800	40,700
Conventional Hangar	0	6,700	7,500	9,700	13,400
Total Maintenance Area (s.f.)	0	10,000	6,200	8,800	13,000
Total Required Hangar Area (s.f.)	15,400	43,600	47,300	67,200	99,900

From the analysis in **Table 3D**, it is apparent that the number of existing hangars do not meet current storage demands. Therefore, short through long term facility planning may be determined to include all three hangar types. It should be noted that the trend toward use of executive hangars in lieu of conventional style hangars may allow for a shift of allotted square footages accordingly. Short term needs should consider replacement of existing hangars, so they may be removed by the intermediate term planning period.

Aircraft Parking Apron

A parking apron should be provided, at a minimum, for based aircraft not stored in hangars and maintenance operations, as well as transient aircraft. At the present time, there are 27 single/multi-engine piston tie-downs for a total of 11,100 square yards of apron space.

To understand apron area needs, busy day figures were used to first determine the number of itinerant and local aircraft, based on a 60:40 split in operations by total busy day aircraft. A multiplier (.25) was used to determine the actual number of itinerant aircraft on the ground. Total apron area requirements were determined by applying a planning criterion of 600 square yards for itinerant single and multi-engine piston aircraft (90 percent of busy day itinerant requiring tie-down), 1,200 square yards for itinerant and/or local jet aircraft (10 percent of busy day itinerant requiring tie-down), and 360 square yards for local piston aircraft (10 percent of busy day local requiring tie-down, including maintenance and permanent tie-downs).The results of this analysis are presented in **Table 3E, Aircraft Parking Apron Requirements.**

TABLE 3E
Aircraft Parking Apron Requirements
San Manuel Airport

	Currently Available	Short Term	Intermediate Term	Long Term
Single, Multi-engine Transient Aircraft Positions		6	10	16
Apron Area (s.y.)		3,400	6,200	9,600
Jet Transient Positions		1	1	2
Apron Area (s.y.)		1,200	1,200	2,400
Locally-Based Aircraft Positions		5	6	8
Apron Area (s.y.)		1,800	2,200	2,900
Total Positions	26	12	17	26
Total Apron Area (s.y.)	11,100	6,400	9,600	14,900

Based on the available 11,100 square yards of apron space, additional aircraft apron area will be needed only for itinerant jet or other large aircraft, such as the Air Tractor (59.2-foot wingspan) until the long term planning period.

Previous reports by local pilots indicate moderate itinerant (Army) helicopter activity. Parking needs for several itinerant helicopters should also be evaluated.

General Aviation Terminal Facilities

General aviation terminal facilities have a variety of functions and, therefore, space needs. Building space is required for passenger waiting, the pilots' lounge and flight planning area, concessions, management, storage, and various other needs. At San Manuel Airport, the pilots' lounge/terminal functions out of a small office facility. The office is approximately 200 square feet in area. There is no FBO or fuel concession.

The selected methodology used to estimate general aviation terminal facility needs was based upon recommendations from FAA *Advisory Circular 150/5300-13* and uses the design hour number of passengers to estimate expected facility need. **Table 3F, General Aviation Terminal Area Facilities** indicates that a planning average of four itinerant passengers per design hour in the short term, increasing to 10 passengers by the long term, was multiplied by 90 square feet to determine an approximate amount of square feet of terminal building space that will be needed.

TABLE 3F
General Aviation Terminal Area Facilities
San Manuel Airport

	Short Term	Intermediate Term	Long Term
General Aviation Design Hour Itinerant Passengers	4	6	10
General Aviation Building Space (s.f.)	360	540	900

VEHICLE ACCESS

In 2003, a new entrance road the airport is to be developed from Redington Road. This road will be less than one mile long, compared to the circuitous 1.3 mile long previous entrance through BHP Billiton property. Signage on Redington Road should be improved to indicate the new airport entrance.

VEHICLE PARKING

Vehicle parking demands have been determined for San Manuel Airport. Space determinations were based on an evaluation of existing airport use as well as industry standards. Automobile parking spaces required to meet general aviation demand were calculated by adding the hangar and terminal areas for short term, intermediate term, and long term. The standard of 400 square feet per vehicle space needed was applied. Parking requirements are summarized in **Table 3G**.

FUEL STORAGE

Fuel storage at San Manuel Airport includes one above-ground fuel storage tank that stores 2,000 gallons of 100 low-lead fuel. Consideration should be given to relocation of the fueling facility and having sufficient fuel to meet future demands by both piston and turbine aircraft.

UTILITIES

The airport is served by only limited electrical, water, and telephone service to the on-airport residence. This service is not sufficient for expansion of facilities, to provide fire protection, or for improving airfield lighting. Facility planning should include upgrading all primary utilities at the airport including electrical, water, sanitary sewer, and communication.

FENCING

The airport lease boundary is presently equipped with barded wire fencing. Facility planning should include chain link fencing around the airport perimeter for greater access restriction and to prevent inadvertent wildlife access to the airport. Consideration should also be given to fencing-off the aircraft operations area. This will prevent the inadvertent access to the aircraft operations by people or vehicles and provide greater security for based and transient aircraft.

TABLE 3G
Vehicle Parking Requirements
San Manuel Airport

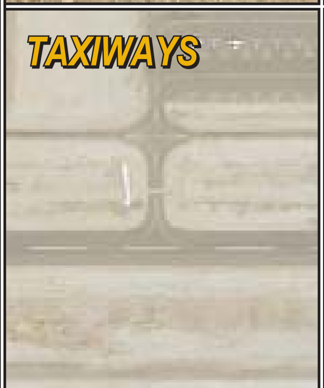
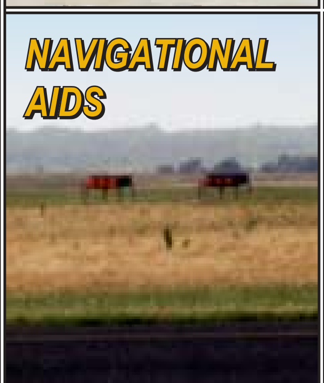
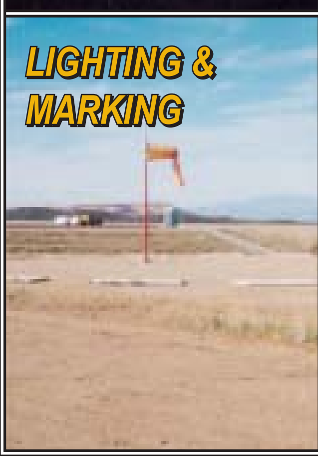
	Future Requirements		
	Short Term	**Intermediate Term**	**Long Term**
Design Hour Passengers	9	16	20
Terminal Vehicle Spaces Needed	12	21	26
Parking Area (s.f.)	4,800	8,400	10,400
General Aviation Spaces Needed	15	20	28
Parking Area (s.f.)	6,000	8,000	11,200
Total Parking Spaces	27	41	54
Total Parking Area (s.f.)	10,800	16,400	21,600

SUMMARY

The intent of this chapter has been to outline the facilities required to meet potential aviation demands projected for San Manuel Airport for the planning horizon. A summary of airfield and landside general aviation facility requirements is presented on **Exhibits 3C** and **3D**.

The following step will be to use this analysis of facility requirements to formulate a direction for development which best meets these projected needs. The remainder of the master plan will be devoted to outlining this direction, its schedule, and its costs.

00MP04-3C-5/9/03

	EXISTING	SHORT TERM	LONG TERM
 RUNWAYS	**Runway 11-29** 4,214' x 75' 12,000 SWL	**Runway 11-29** 4,214' x 75' 12,000 SWL	**Runway 11-29** 4,800' x 75' Same 30,000 SWL Remove Buildings from OFA
 TAXIWAYS	**Runway 11-29** Partial Parallel Taxiway Four Exits Portions Unpaved	**Runway 11-29** Pave and Widen Parallel	**Runway 11-29** Full Parallel Taxiway Five Exits
 NAVIGATIONAL AIDS	**Runway 11-29** None	**Runway 11-29** AWOS-3	**Runway 11-29** Same One-mile Visibility Minimum Instrument Approach Procedure
 LIGHTING & MARKING	Segmented Circle Windcone Basic Runway Markings **Runway 11-29**	Same **Runway 11-29** Rotating Beacon Lighted Windcone REILs 11 and 29 MIRL MITL PAPI-4 11 and 29	Same **Runway 11-29** Same Nonprecision Markings

San Manuel AIRPORT

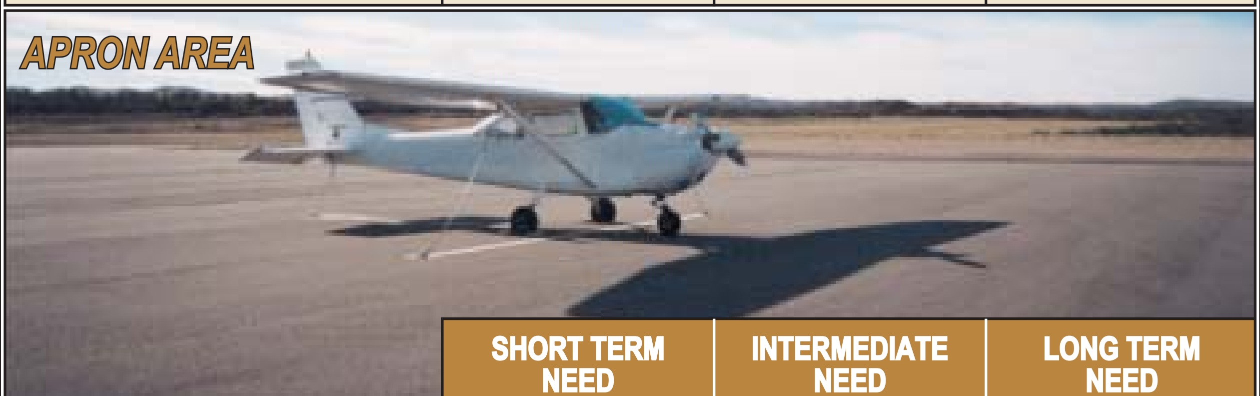
Exhibit 3C
AIRFIELD FACILITY REQUIREMENTS

01MP17-3D-1/25/01

AIRCRAFT STORAGE HANGARS

	SHORT TERM NEED	INTERMEDIATE NEED	LONG TERM NEED
T-hangar Positions	20	22	27
Executive Hangar Positions	6	10	18
Conventional Hangar Positions	6	7	9
T-hangar Area (s.f.)	23,500	26,900	32,800
Executive Hangar Area (s.f.)	10,100	21,800	40,700
Conventional Hangar Area (s.f.)	7,500	9,700	13,400
Maintenance Area (s.f.)	6,200	8,800	13,000
Total Hangar Area (s.f.)	47,300	67,200	99,900

APRON AREA



	SHORT TERM NEED	INTERMEDIATE NEED	LONG TERM NEED
Small Itinerant Positions	6	10	16
Large Itinerant Positions	1	1	2
Locally-Based Aircraft Positions	5	6	8
Total Positions	12	17	26
Total Apron Area (s.y.)	6,400	9,600	14,900

TERMINAL SERVICES & VEHICLE PARKING

	SHORT TERM NEED	INTERMEDIATE NEED	LONG TERM NEED
Terminal Building Space (s.f.)	300	600	900
Total Parking Spaces	27	41	54
Total Parking Area (s.f.)	10,900	16,300	21,400

San Manuel AIRPORT

Exhibit 3D
LANDSIDE FACILITY REQUIREMENTS